What is claimed is:

1. A method for enzymatically producing defined glycosaminoglycan polymers comprising the steps of:

providing at least one functional acceptor, wherein the functional acceptor has at least two sugar units selected from the group consisting of uronic acid, hexosamine and structural variants or derivatives thereof;

providing at least one recombinant glycosaminoglycan transferase capable of elongating the at least one functional acceptor in a controlled fashion to form extended glycosaminoglycan-like molecules; and

providing at least one UDP-sugar selected from the group consisting of UDP-GlcUA, UDP-GlcNAc, UDP-Glc, UDP-GalNAc, UDP-GlcN, UDP-GalN and structural variants or derivatives thereof in a stoichiometric ratio to the at least one functional acceptor such that the at least one recombinant glycosaminoglycan transferase elongates the at least one functional acceptor to provide glycosaminoglycan polymers wherein the glycosaminoglycan polymers have a desired size distribution such that the glycosaminoglycan polymers are substantially monodisperse in size, and wherein the desired size distribution is obtained by controlling the stoichiometric ratio of UDP-sugar to functional acceptor.

2. The method of claim 1 wherein, in the step of providing at least one functional acceptor, uronic acid is further defined as a uronic acid selected from the group consisting of GlcUA, IdoUA, GalUA, and structural variants or derivatives thereof.

3. The method of claim 1 wherein, in the step of providing at least one functional acceptor, hexosamine is further defined as a hexosamine selected from the group consisting of GlcNAc, GalNAc, GlcN, GalN, and structural variants or derivatives thereof.

4. The method of claim 1 wherein, in the step of providing at least one functional acceptor, the functional acceptor is an HA oligosaccharide having between about three sugar units and about 4.2 kDa.

5. The method of claim 1 wherein, in the step of providing at least one functional acceptor, the functional acceptor is an HA polymer having a mass in a range of from about 3.5 kDa to about 2 MDa.

6. The method of claim 1 wherein, in the step of providing at least one functional acceptor, the functional acceptor is a chondroitin oligosaccharide comprising at least about three sugar units.

7. The method of claim 1 wherein, in the step of providing at least one functional acceptor, the functional acceptor is a chondroitin polymer.

8. The method of claim 1 wherein, in the step of providing at least one functional acceptor, the functional acceptor is a chondroitin sulfate polymer.

9. The method of claim 1 wherein, in the step of providing at least one functional acceptor, the functional acceptor is a heparosan-like polymer.

10. The method of claim 1 wherein, in the step of providing at least one functional acceptor, the functional acceptor is an extended acceptor selected from the group consisting of HA chains, chondroitin chains, heparosan chains, mixed glycosaminoglycan chains, analog containing chains, and combinations thereof.

11. The method of claim 1 wherein, in the step of providing at least one recombinant glycosaminoglycan transferase, the at least one recombinant glycosaminoglycan transferase is selected from the group consisting of a recombinant hyaluronan synthase or active fragment or mutant thereof, a recombinant chondroitin synthase or active fragment or mutant thereof, a recombinant heparosan synthase or active fragment or mutant thereof and combinations thereof.

12. The method of claim 11 wherein the at least one recombinant glycosaminoglycan transferase is selected from the group consisting of a recombinant PmHAS or active fragment or mutant thereof, a recombinant PmCS or active fragment or mutant thereof, a recombinant heparosan synthase or active fragment or mutant thereof and combinations thereof.

13. The method of claim 1 wherein, in the step of providing at least one recombinant glycosaminoglycan transferase, the at least one recombinant glycosaminoglycan transferase comprises a recombinant single action glycosyltransferase capable of adding only one of GlcUA, GlcNAc, Glc, GalNAc, GlcN, GalN or a structural variant or derivative thereof.

14. The method of claim 1 wherein, in the step of providing at least one recombinant glycosaminoglycan transferase, the at least one recombinant glycosaminoglycan transferase comprises a recombinant synthetic chimeric glycosaminoglycan transferase capable of adding two or more of GlcUA, GlcNAc, Glc, GalNAc, GlcN, GalN and a structural variant or derivative thereof .

15. The method of claim 1, wherein the at least one recombinant glycosaminoglycan transferase is immobilized and the at least one functional acceptor and the at least one of UDP-GlcUA, UDP-GlcNAc, UDP-Glc, UDP-GalNAc, UDP-GlcN, UDP-GalN and a structural variant or derivative thereof are in a liquid phase.

16. The method of claim 1, wherein the at least one functional acceptor is immobilized and the at least one UDP-sugar are in a liquid phase.

17. The method of claim 1, further comprising the step of providing a divalent metal ion.

18. The method of claim 17, wherein the divalent metal ion is selected from the group consisting of manganese, magnesium, cobalt, nickel and combinations thereof.

19. The method of claim 1, wherein the method occurs in a buffer having a pH from about 6 to about 8.

20. The method of claim 1 wherein, in the step of providing the at least one recombinant glycosaminoglycan transferase, the at least one recombinant glycoasminoglycan transferase has an amino acid sequence encoded by a nucleotide sequence capable of hybridizing under standard stringent, moderately stringent, or less stringent hybridization conditions to a nucleotide sequence selected from the group consisting of SEQ ID NOS:1, 3, 26 or 71.

21. The method of claim 1 wherein, in the step of providing the at least one recombinant glycosaminoglycan transferase, the at least one recombinant glycoasminoglycan transferase has an amino acid sequence essentially as set forth in SEQ ID NO:2, 4 or 72.

22. The method of claim 1 wherein, in the step of providing the at least one recombinant glycosaminoglycan transferase, the at least recombinant glycoasminoglycan transferase is encoded by a nucleotide sequence essentially as set forth in SEQ ID NO:1, 3, 26 or 71.

23. The method of claim 1 wherein the substantially monodisperse glycosaminoglycan polymers have a molecular weight in a range of from about 3.5 kDa to about 0.5 MDa.

24. The method of claim 23 wherein the substantially monodisperse glycosaminoglycan polymers have a polydispersity value in a range of from about 1.0 to about 1.1.

25. The method of claim 24 wherein the substantially monodisperse glycosaminoglycan polymers have a poldispersity value in a range of from about 1.0 to about 1.05.

26. The method of claim 1 wherein the substantially monodisperse glycosaminoglycan polymers have a molecular weight in a range of from about 0.5 MDa to about 4.5 MDa.

27. The method of claim 26 wherein the substantially monodisperse glycosaminoglycan polymers have a polydispersity value in a range of from about 1.0 to about 1.5.

28. The method of claim 27 wherein the substantially monodisperse glycosaminoglycan polymers have a polydispersity value in a range of from about 1.0 to about 1.2.

29. The method of claim 1 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor comprises a moiety selected from the group consisting of a fluorescent tag, a radioactive tag, an affinity tag, a detection probe, a medicant, and combinations thereof.

30. The method of claim 1 wherein, in the step of providing at least one UDP-sugar, at least one UDP-sugar is radioactively labeled.

31. The method of claim 1 wherein the glycosaminoglycan polymers are chimeric or hybrid glycosaminoglycans having a non-natural structure.

32. The method of claim 1 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor is a plurality of functional acceptors immobilized on a substrate.

33. The method of claim 1 wherein, in the step of providing at least one functional acceptor,

the at least one functional acceptor is a plurality of functional acceptors in a liquid phase.

34. The method of claim 1 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor is immobilized on a microtiter plate.

35. The method of claim 1 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor is immobilized on a microarray slide.

36. The method of claim 1 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor is sulfated or is a modified oligosaccharide.

37. A plurality of defined glycosaminoglycan polymers being substantially mondisperse in size, the plurality of glycoasminoglycan polymers produced by the method comprising the steps of:

providing more than one functional acceptor, wherein the more than one functional acceptors each have at least two sugar units selected from the group consisting of uronic acid, hexosamine and structural variants or derivatives thereof;

providing at least one recombinant glycosaminoglycan transferase capable of elongating the functional acceptors in a controlled fashion to form extended glycosaminoglycan-like molecules; and

providing at least one UDP-sugar selected from the group consisting of UDP-GlcUA, UDP-GlcNAc, UDP-Glc, UDP-GalNAc, UDP-GlcN, UDP-GalN and structural variants or derivatives thereof in a stoichiometric ratio to the more than one functional acceptors such that the glycosaminoglycan transferase elongates the functional acceptors to provide glycosaminoglycan polymers wherein the glycosaminoglycan polymers have a desired size distribution such that the glycosaminoglycan polymers are substantially monodisperse in size, and wherein the desired size distribution is obtained by controlling the stoichiometric ratio of UDP-sugar to functional acceptor.

38. A method for enzymatically producing defined glycosaminoglycan polymers comprising the steps of:

providing at least one functional acceptor, wherein the functional acceptor has at least two sugar units selected from the group consisting of uronic acid, hexosamine and structural variants and derivatives thereof;

providing at least one recombinant glycosaminoglycan transferase capable of elongating the at least one functional acceptor in a repetitive fashion to form extended glycosaminoglycan-like molecules; and

providing at least one UDP-sugar selected from the group consisting of UDP-GlcUA, UDP-GlcNAc, UDP-Glc, UDP-GalNAc, UDP-GlcN, UDP-GalN and structural variants or derivatives thereof in a stoichiometric ratio to the at least one functional acceptor such that the at least one recombinant glycosaminoglycan transferase elongates the at least one functional acceptor to provide glycosaminoglycan polymers wherein the glycosaminoglycan polymers have a desired size distribution such that the glycosaminoglycan polymers are substantially monodisperse in size, and wherein the desired size distribution is obtained by controlling the stoichiometric ratio of UDP-sugar to functional acceptor.

39. The method of claim 38 wherein, in the step of providing at least one functional acceptor, uronic acid is further defined as a uronic acid selected from the group consisting of GlcUA, IdoUA, GalUA, and structural variants or derivatives thereof.

40. The method of claim 38 wherein, in the step of providing at least one functional acceptor, hexosamine is further defined as a hexosamine selected from the group consisting of GlcNAc, GalNAc, GlcN, GalN, and structural variants or derivatives thereof.

41. The method of claim 38 wherein, in the step of providing at least one functional acceptor, the functional acceptor is an HA oligosaccharide having between about three sugar units and about 4.2 kDa.

42. The method of claim 38 wherein, in the step of providing at least one functional acceptor, the functional acceptor is an HA polymer having a mass in a range of from about 3.5 kDa to about 2 MDa.

43. The method of claim 38 wherein, in the step of providing at least one functional acceptor, the functional acceptor is a chondroitin oligosaccharide comprising at least about three sugar units.

44. The method of claim 38 wherein, in the step of providing at least one functional acceptor, the functional acceptor is a chondroitin polymer.

45. The method of claim 38 wherein, in the step of providing at least one functional acceptor, the functional acceptor is a chondroitin sulfate polymer.

46. The method of claim 38 wherein, in the step of providing at least one functional acceptor, the functional acceptor is a heparosan-like polymer.

47. The method of claim 38 wherein, in the step of providing at least one functional acceptor, the functional acceptor is an extended acceptor selected from the group consisting of HA chains, chondroitin chains, heparosan chains, mixed glycosaminoglycan chains, analog containing chains, and combinations thereof.

48. The method of claim 38 wherein, in the step of providing at least one recombinant glycosaminoglycan transferase, the at least one recombinant glycosaminoglycan transferase is selected from the group consisting of a recombinant hyaluronan synthase or active fragment or mutant thereof, a recombinant chondroitin synthase or active fragment or mutant thereof, a recombinant heparosan synthase or active fragment or mutant thereof and combinations thereof.

49. The method of claim 48 wherein the at least one recombinant glycosaminoglycan transferase is selected from the group consisting of a recombinant PmHAS or active fragment or mutant thereof, a recombinant PmCS or active fragment or mutant thereof, a recombinant heparosan synthase or active fragment or mutant thereof and combinations thereof.

50. The method of claim 38 wherein, in the step of providing at least one recombinant glycosaminoglycan transferase, the at least one recombinant glycosaminoglycan transferase comprises a recombinant single action glycosyltransferase capable of adding only one of GlcUA, GlcNAc, Glc, GalNAc, GlcN, GalN or a structural variant or derivative thereof .

51. The method of claim 38 wherein, in the step of providing at least one recombinant glycosaminoglycan transferase, the at least one recombinant glycosaminoglycan transferase comprises a recombinant synthetic chimeric glycosaminoglycan transferase capable of adding two or more of GlcUA, GlcNAc, Glc, GalNAc, GlcN, GalN and a structural variant or derivative thereof.

52. The method of claim 38, wherein the at least one recombinant glycosaminoglycan transferase is immobilized and the at least one functional acceptor and the at least one UDP-sugar are in a liquid phase.

53. The method of claim 38, wherein the at least one functional acceptor is immobilized and the at least one UDP-sugar are in a liquid phase.

54. The method of claim 38, further comprising the step of providing a divalent metal ion.

55. The method of claim 54, wherein the divalent metal ion is selected from the group consisting of manganese, magnesium, cobalt, nickel, calcium and combinations thereof.

56. The method of claim 38, wherein the method occurs in a buffer having a pH from about 6 to about 8.

57. The method of claim 38 wherein, in the step of providing the at least one recombinant glycosaminoglycan transferase, the at least one recombinant glycoasminoglycan transferase has an amino acid sequence encoded by a nucleotide sequence capable of hybridizing under standard stringent, moderately stringent, or less stringent hybridization conditions to a nucleotide sequence selected from the group consisting of SEQ ID NOS:1, 3, 26 or 71.

58. The method of claim 38 wherein, in the step of providing the at least one recombinant glycosaminoglycan transferase, the at least one recombinant glycoasminoglycan transferase has an amino acid sequence essentially as set forth in SEQ ID NO:2, 4 or 72.

59. The method of claim 38 wherein, in the step of providing the at least one recombinant glycosaminoglycan transferase, the at least recombinant glycoasminoglycan transferase is encoded by a nucleotide sequence essentially as set forth in SEQ ID NO:1, 3, 26 or 71.

60. The method of claim 38 wherein the substantially monodisperse glycosaminoglycan polymers have a molecular weight in a range of from about 3.5 kDa to about 0.5 MDa.

61. The method of claim 60 wherein the substantially monodisperse glycosaminoglycan polymers have a polydispersity value in a range of from about 1.0 to about 1.1.

62. The method of claim 61 wherein the substantially monodisperse glycosaminoglycan polymers have a polydispersity value in a range of from about 1.0 to about 1.05.

63. The method of claim 38 wherein the substantially monodisperse glycosaminoglycan polymers have a molecular weight in a range of from about 0.5 MDa to about 4.5 MDa.

64. The method of claim 63 wherein the substantially monodisperse glycosaminoglycan polymers have a polydispersity value in a range of from about 1.0 to about 1.5.

65. The method of claim 64 wherein the substantially monodisperse glycosaminoglycan polymers have a polydispersity value in a range of from about 1.0 to about 1.2.

66. The method of claim 38 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor comprises a moiety selected from the group consisting of a fluorescent tag, a radioactive tag, an affinity tag, a detection probe, a medicant, and combinations thereof.

67. The method of claim 38 wherein, in the step of providing at least one UDP-sugar, at least one UDP-sugar is radioactively labeled.

68. The method of claim 38 wherein the glycosaminoglycan polymers are chimeric or hybrid glycosaminoglycans having a non-natural structure.

69. The method of claim 38 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor is a plurality of functional acceptors immobilized on a substrate.

70. The method of claim 38 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor is a plurality of functional acceptors in a liquid phase.

71. The method of claim 38 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor is immobilized on a microtiter plate.

72. The method of claim 38 wherein, in the step of providing at least one functional acceptor,

the at least one functional acceptor is immobilized on a microarray slide.

73. The method of claim 38 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor is sulfated or is a modified oligosaccharide.

74. The method of claim 38 wherein the ratio of UDP-sugar to functional acceptor is low to produce products with small sizes.

75. The method of claim 38 wherein the ratio of UDP-sugar to functional acceptor is high to produce products with large sizes.

76. A plurality of defined glycosaminoglycan polymers being substantially mondisperse in size, the plurality of glycoasminoglycan polymers produced by the method comprising the steps of:

providing more than one functional acceptor, wherein the more than one functional acceptors each have at least two sugar units selected from the group consisting of uronic acid, hexosamine, and structural variants or derivatives thereof;

providing at least one recombinant glycosaminoglycan transferase capable of elongating the functional acceptors in a repetitive fashion to form extended glycosaminoglycan-like molecules; and

providing at least one UDP-sugar selected from the group consisting of UDP-GlcUA, UDP-GlcNAc, UDP-Glc, UDP-GalNAc, UDP-GlcN, UDP-GalN and structural variants or derivatives thereof in a stoichiometric ratio to the more than one functional acceptors such that the glycosaminoglycan transferase elongates the functional acceptors to provide glycosaminoglycan polymers wherein the glycosaminoglycan polymers have a desired size distribution such that the glycosaminoglycan polymers are substantially monodisperse in size, and wherein the desired size distribution is obtained by controlling the stoichiometric ratio of UDP-sugar to functional acceptor.

77. A method for enzymatically producing defined glycosaminoglycan polymers comprising the steps of:

providing at least one functional acceptor, wherein the functional acceptor is selected from the group consisting of an HA polymer, a chondroitin polymer, a chondroitin sulfate polymer, a heparosan-like polymer, mixed GAG chains, analog containing

chains and combinations thereof;

providing at least one recombinant glycosaminoglycan transferase capable of elongating the at least one functional acceptor in a controlled fashion to form extended glycosaminoglycan-like molecules; and

providing at least one UDP-sugar selected from the group consisting of UDP-GlcUA, UDP-GlcNAc, UDP-Glc, UDP-GalNAc, UDP-GlcN, UDP-GalN and structural variants or derivatives thereof in a stoichiometric ratio to the at least one functional acceptor such that the at least one recombinant glycosaminoglycan transferase elongates the at least one functional acceptor to provide glycosaminoglycan polymers wherein the glycosaminoglycan polymers have a desired size distribution greater than 1 MDa, and wherein the desired size distribution is obtained by controlling the stoichiometric ratio of UDP-sugar to functional acceptor.

78. The method of claim 77 wherein, in the step of providing at least one functional acceptor, the functional acceptor is an HA polymer having a mass in a range of from about 3.5 kDa to about 2 MDa.

79. The method of claim 77 wherein, in the step of providing at least one recombinant glycosaminoglycan transferase, the at least one recombinant glycosaminoglycan transferase is selected from the group consisting of a recombinant hyaluronan synthase or active fragment or mutant thereof, a recombinant chondroitin synthase or active fragment or mutant thereof, a recombinant heparosan synthase or active fragment or mutant thereof and combinations thereof.

80. The method of claim 79 wherein the at least one recombinant glycosaminoglycan transferase is selected from the group consisting of a recombinant PmHAS or active fragment or mutant thereof, a recombinant PmCS or active fragment or mutant thereof, a recombinant heparosan synthase or active fragment or mutant thereof and combinations thereof.

81. The method of claim 77 wherein, in the step of providing at least one recombinant glycosaminoglycan transferase, the at least one recombinant glycosaminoglycan transferase comprises a recombinant single action glycosyltransferase capable of adding only one of GlcUA, GlcNAc, Glc, GalNAc, GlcN, GalN or a structural variant or derivative thereof.

82. The method of claim 77 wherein, in the step of providing at least one recombinant glycosaminoglycan transferase, the at least one recombinant glycosaminoglycan transferase comprises a recombinant synthetic chimeric glycosaminoglycan transferase capable of adding two or more of GlcUA, GlcNAc, Glc, GalNAc, GlcN, GalN and a structural variant or derivative thereof .

83. The method of claim 77, wherein the at least one recombinant glycosaminoglycan transferase is immobilized and the at least one functional acceptor and the at least one UDP-sugar are in a liquid phase.

84. The method of claim 77, wherein the at least one functional acceptor is immobilized and the at least one UDP-sugar are in a liquid phase.

85. The method of claim 77, further comprising the step of providing a divalent metal ion.

86. The method of claim 85, wherein the divalent metal ion is selected from the group consisting of manganese, magnesium, cobalt, nickel and combinations thereof.

87. The method of claim 77, wherein the method occurs in a buffer having a pH from about 6 to about 8.

88. The method of claim 77 wherein, in the step of providing the at least one recombinant glycosaminoglycan transferase, the at least one recombinant glycoasminoglycan transferase has an amino acid sequence encoded by a nucleotide sequence capable of hybridizing under standard stringent, moderately stringent, or less stringent hybridization conditions to a nucleotide sequence selected from the group consisting of SEQ ID NOS:1, 3, 26 or 71.

89. The method of claim 77 wherein, in the step of providing the at least one recombinant glycosaminoglycan transferase, the at least one recombinant glycoasminoglycan transferase has an amino acid sequence essentially as set forth in SEQ ID NO:2, 4 or 72.

90. The method of claim 77 wherein, in the step of providing the at least one recombinant glycosaminoglycan transferase, the at least recombinant glycoasminoglycan transferase is encoded by a nucleotide sequence essentially as set forth in SEQ ID NO:1, 3, 26 or 71.

91. The method of claim 77 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor comprises a moiety selected from the group consisting of a fluorescent tag, a radioactive tag, an affinity tag, a detection probe, a medicant, and combinations thereof.

92. The method of claim 77 wherein, in the step of providing at least one UDP-sugar, at least one UDP-sugar is radioactively labeled.

93. The method of claim 77 wherein the glycosaminoglycan polymers are chimeric or hybrid glycosaminoglycans having a non-natural structure.

94. The method of claim 77 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor is a plurality of functional acceptors immobilized on a substrate.

95. The method of claim 77 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor is a plurality of functional acceptors in a liquid phase.

96. The method of claim 77 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor is immobilized on a microtiter plate.

97. The method of claim 77 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor is immobilized on a microarray slide.

98. The method of claim 77 wherein, in the step of providing at least one functional acceptor, the at least one functional acceptor is sulfated or is a modified oligosaccharide.

99. The method of claim 77 wherein the ratio of UDP-sugar to functional acceptor is low to produce products with small sizes.

100. The method of claim 77 wherein the ratio of UDP-sugar to functional acceptor is high to produce products with large sizes.

101. A method for producing a polysaccharide biomaterial, comprising the steps of:

providing at least one functional acceptor, wherein the functional acceptor has at least two sugar units selected from the group consisting of uronic acid, hexosamine and structural variants or derivatives thereof;

providing at least one recombinant glycosaminoglycan transferase capable of elongating the at least one functional acceptor in a controlled fashion to form extended glycosaminoglycan-like molecules; and

providing at least one UDP-sugar selected from the group consisting of UDP-GlcUA, UDP-GlcNAc, UDP-Glc, UDP-GalNAc, UDP-GlcN, UDP-GalN and structural variants or derivatives thereof in a stoichiometric ratio to the at least one functional acceptor such that the at least one recombinant glycosaminoglycan transferase elongates the at least one functional acceptor to provide glycosaminoglycan polymers wherein the glycosaminoglycan polymers have a desired size distribution such that the glycosaminoglycan polymers are substantially monodisperse in size, and wherein the desired size distribution is obtained by controlling the stoichiometric ratio of UDP-sugar to functional acceptor, and whereby the glycosaminoglycan polymers are capable of acting as a bioadhesive sealant, a tissue engineering aid, a cell matrix mimetic, a cell behavior or growth modulator, a drug delivery agent, or combinations thereof.

102. A polysaccharide bioadhesive sealant manufactured according to the process of claim 101.

103. A polysaccharide tissue engineering aid manufactured according to the process of claim 101.

104. A polysaccharide cell matrix mimetic manufactured according to the process of claim 101.

105. A polysaccharide cell behavior or growth modulator manufactured according to the process of claim 101.

106. A drug delivery agent manufactured according to the process of claim 103.

107. A method for producing a polysaccharide biomaterial containing a medicament delivery assembly, comprising the steps of:

providing at least one functional acceptor, wherein the functional acceptor has at least two sugar units selected from the group consisting of uronic acid, hexosamine and structural variants or derivatives thereof;

providing at least one recombinant glycosaminoglycan transferase capable of elongating the at least one functional acceptor in a controlled fashion to form extended glycosaminoglycan-like molecules; and

providing at least one UDP-sugar selected from the group consisting of UDP-GlcUA, UDP-GlcNAc, UDP-Glc, UDP-GalNAc, UDP-GlcN, UDP-GalN and structural variants or derivatives thereof in a stoichiometric ratio to the at least one functional acceptor such that the at least one recombinant glycosaminoglycan transferase elongates the at least one functional acceptor to provide glycosaminoglycan polymers wherein the glycosaminoglycan polymers have a desired size distribution such that the glycosaminoglycan polymers are substantially monodisperse in size, and wherein the desired size distribution is obtained by controlling the stoichiometric ratio of UDP-sugar to functional acceptor, and whereby the glycosaminoglycan polymers are capable of acting as a polysaccharide bioadhesive;

providing at least one medicament delivery assembly containing one or more medicaments entrapped therein and deliverable within a wound site or a surgical site; and

mixing the prepared polysaccharide bioadhesive with the at least one medicament delivery assembly, wherein the prepared polysaccharide bioadhesive entraps the at least one medicament delivery assembly to produce a polysaccharide biomaterial containing a medicament delivery system.

108. A polysaccharide biomaterial containing a medicament delivery assembly manufactured according to the process of claim 107.

109. A method for producing a polysaccharide biomaterial containing a medicament delivery system for administration at a wound, ulcer, injury or surgical site, comprising the steps of:

providing at least one functional acceptor, wherein the functional acceptor has at least two sugar units selected from the group consisting of uronic acid, hexosamine and structural variants or derivatives thereof;

providing at least one recombinant glycosaminoglycan transferase capable of elongating the at least one functional acceptor in a controlled fashion to form extended glycosaminoglycan-like molecules; and

providing at least one UDP-sugar selected from the group consisting of UDP-GlcUA, UDP-GlcNAc, UDP-Glc, UDP-GalNAc, UDP-GlcN, UDP-GalN and structural variants or derivatives thereof in a stoichiometric ratio to the at least one functional acceptor such that the at least one recombinant glycosaminoglycan transferase elongates the at least one functional acceptor to provide glycosaminoglycan polymers wherein the glycosaminoglycan polymers have a desired size distribution such that the glycosaminoglycan polymers are substantially monodisperse in size, and wherein the desired size distribution is obtained by controlling the stoichiometric ratio of UDP-sugar to functional acceptor, and whereby the glycosaminoglycan polymers are capable of acting as a polysaccharide bioadhesive;

providing at least one medicament delivery assembly containing one or more medicaments entrapped therein; and

mixing the prepared polysaccharide bioadhesive with the at least one medicament delivery assembly, wherein the prepared polysaccharide bioadhesive entraps the at least one medicament delivery assembly to provides a polysaccharide biomaterial containing a medicament delivery assembly.

110. A polysaccharide biomaterial containing a medicament delivery system manufactured according to the process of claim 109.

111. A biomaterial composition, comprising:

an effective amount of a polysaccharide polymer produced by the method comprising the steps of:

providing at least one functional acceptor, wherein the functional acceptor has at least two sugar units selected from the group consisting of uronic acid, hexosamine and structural variants or derivatives thereof;

providing at least one recombinant glycosaminoglycan transferase capable of elongating the at least one functional acceptor in a controlled fashion to form extended glycosaminoglycan-like molecules; and

providing at least one UDP-sugar selected from the group consisting of UDP-GlcUA, UDP-GlcNAc, UDP-Glc, UDP-GalNAc, UDP-GlcN, UDP-GalN and

structural variants or derivatives thereof in a stoichiometric ratio to the at least one functional acceptor such that the at least one recombinant glycosaminoglycan transferase elongates the at least one functional acceptor to provide glycosaminoglycan polymers wherein the glycosaminoglycan polymers have a desired size distribution such that the glycosaminoglycan polymers are substantially monodisperse in size, and wherein the desired size distribution is obtained by controlling the stoichiometric ratio of UDP-sugar to functional acceptor; and

at least one medicament delivery assembly containing at least one medicament, wherein the at least one medicament delivery assembly is embedded in the glycosaminoglycan polymer so as to localize the at least one medicament within the glycosaminoglycan polymer bioadhesive composition.